

TRANSLATION OF AMENDMENT (JAN.17.2005)  
UNDER ARTICLE 34 OF PCT

- We cancelled claims 15-26 and 30.
- We amended claim 27.

Rec'd PCTO

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# 手続補正書

(法第11条の規定による補正)



特許庁審査官 宮崎 園子 殿

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## 4. 補正の対象 請求の範囲

## 5. 補正の内容

(1) 請求の範囲第15項から第26項を削除する。請求の範囲第27頁は補正により削除。

(2) 請求の範囲第27項を補正する。

(3) 請求の範囲第30項を削除する。

6. 添付書類の目録 請求の範囲第26頁、第28頁、  
請求の範囲第30頁、第31頁。

12. 前記面状発熱体は、抵抗発熱体をセラミック中空板状体中に封入して構成されている

ことを特徴とする請求項9に記載の熱処理装置。

13. 前記セラミックは、石英である

ことを特徴とする請求項11または12に記載の熱処理装置。

14. 前記第2加熱部は、水平方向に移動可能に支持されていることを特徴とする請求項1乃至13のいずれかに記載の熱処理装置。

15. (削除)

22. (削除)

23. (削除)

24. (削除)

25. (削除)

26. (削除)

27. (補正後) 上端に開口部を有する加熱炉本体と、  
前記加熱炉本体の内部に収容された単一の管からなる反応管と、  
前記反応管の上部に狭径状に形成された排気手段接続部と、  
前記加熱炉本体の内部に収容された、被処理基板を支持するための被処理基板  
支持部材と、

前記被処理基板支持部材により支持される被処理基板を加熱するための加熱手  
段と、

前記反応管の下部を密封して、前記反応管の内部を気密に保持する反応管下部  
蓋体と、

複数の温度測定素子を中空管状体中に封止して構成された温度測定手段と、  
を備え、

前記中空管状体は、前記加熱炉本体と前記反応管との間の間隙に配置

前記反応管の上部に狭径状に形成された排気手段接続部と、

前記加熱炉本体の内部に収容された、被処理基板を支持するための被処理基板支持部材と、

前記被処理基板支持部材により支持される被処理基板を加熱するための加熱手段と、

前記反応管の下部を密封して、前記反応管の内部を気密に保持する反応管下部蓋体と、

複数の温度測定素子を第2中空管状体中に封止して構成された第2温度測定手段と、

複数の温度測定素子を第3中空管状体中に封止して構成された第3温度測定手段と、

を備え、

第2中空管状体の少なくとも一部は、前記反応管の上方部から水平に伸びており、

第3中空管状体の少なくとも一部は、前記加熱炉本体と前記反応管との間の間隙に配置されている

ことを特徴とする熱処理装置。

30. (削除)

31. 上端に開口部を有する加熱炉本体と、  
前記加熱炉本体の内部に収容された単一の管からなる反応管と、  
前記反応管の上部に狭径状に形成された排気手段接続部と、  
前記加熱炉本体の内部に収容された、被処理基板を支持するための被処理基板支持部材と、  
前記被処理基板支持部材により支持された被処理基板を加熱するための加熱手段と、  
前記反応管の下部を密封して、前記反応管の内部を気密に保持する反応管下部蓋体と、  
複数の温度測定素子を第2中空管状体中に封止して構成された第2温度測定手段と、  
複数の温度測定素子を第3中空管状体中に封止して構成された第3温度測定手段と、  
を備え、  
前記加熱手段は、  
前記反応管の周囲に配置された第1加熱部と、  
前記排気手段接続部の周囲に配置された第2加熱部と、  
前記反応管の上方部の周囲に配置された第3加熱部と、  
前記反応管の下方部の周囲に配置された第4加熱部と、  
前記被処理基板支持部材の下部に配置された第5加熱部と、  
を有しており、  
第2中空管状体の少なくとも一部は、前記反応管の上方部から水平に伸びており、  
第3中空管状体の少なくとも一部は、前記加熱炉本体と前記反応管との間の間

## CLAIMS

1. A thermal processing unit comprising:
  - a heating-furnace body whose upper end has an opening,
  - a reaction tube consisting of a single tube contained in the heating-furnace body,
  - a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,
  - a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body, and
  - a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member, wherein the heating unit has:
    - a first heating portion arranged around the reaction tube,
    - a second heating portion arranged around the gas-discharging-unit connecting portion,
    - a third heating portion arranged around an upper portion of the reaction tube,
    - a fourth heating portion arranged around a lower portion of the reaction tube, and
    - a fifth heating portion arranged under the substrate-to-be-processed supporting member.
2. A thermal processing unit according to claim 1, wherein the first heating portion is formed by a plurality of linear heat-generating members, which are arranged in parallel with a longitudinal direction of the reaction tube.
3. A thermal processing unit according to claim 1, wherein the first heating portion is formed by a plurality of U-shaped heat-generating members, which are arranged in parallel with a longitudinal direction of the reaction tube.
4. A thermal processing unit according to any of claims 1 to 3, wherein

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the second heating portion is formed by a linear heat-generating member, which is arranged in a spiral pattern.

5. A thermal processing unit according to any of claims 1 to 4, wherein

the third heating portion is formed by a linear heat-generating member, which is arranged in a spiral pattern.

6. A thermal processing unit according to any of claims 1 to 4, wherein

the third heating portion is formed by a linear heat-generating member, which is arranged in a switchback pattern.

7. A thermal processing unit according to any of claims 1 to 6, wherein

the fourth heating portion is formed by a linear heat-generating member, which is arranged in a spiral pattern that is seen as a rectangular in a circumferential direction of the reaction tube.

8. A thermal processing unit according to any of claims 1 to 6, wherein

the fourth heating portion is formed by a linear heat-generating member, which is arranged in a switchback pattern.

9. A thermal processing unit according to any of claims 1 to 8, wherein

the fifth heating portion is formed by a plate-like heat-generating member.

10. A thermal processing unit according to any of claims 1 to 8, wherein

the fifth heating portion is formed by a heat-generating member arranged along a lower surface of the substrate-to-be-processed supporting member.

11. A thermal processing unit according to any of claims 2 to 4 and 8,

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wherein

the linear heat-generating member is formed by sealing a resistance heater into a hollow tubular member made of ceramics.

12. A thermal processing unit according to claim 9, wherein the plate-like heat-generating member is formed by sealing a resistance heater into a hollow plate-like member made of ceramics.

13. A thermal processing unit according to claim 11 or 12, wherein the ceramics is quartz.

14. A thermal processing unit according to any of claims 1 to 13, wherein the second heating portion is supported in a movable manner in a horizontal direction.

15. A thermal processing unit comprising:  
 a heating-furnace body whose upper end has an opening,  
 a reaction tube consisting of a single tube contained in the heating-furnace body,  
 a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,  
 a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,  
 a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member, and  
 a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube,  
 wherein the substrate-to-be-processed supporting member has:  
 a ceiling plate, a bottom plate, and a plurality of columns connecting the ceiling plate and the bottom plate,  
 a pole for supporting the substrate-to-be-processed supporting member is fixed to a central portion of the bottom plate, and  
 grooves for supporting the substrate to be processed are formed on the plurality of columns.

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16. A thermal processing unit according to claim 15, wherein the pole is formed by a hollow member made of quartz.
17. A thermal processing unit comprising:
  - a heating-furnace body whose upper end has an opening,
  - a reaction tube consisting of a single tube contained in the heating-furnace body,
  - a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,
  - a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,
  - a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member,
  - a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube, and
  - a temperature measuring unit formed by sealing a plurality of temperature measuring members into a hollow tubular member.
18. A thermal processing unit according to claim 17, wherein the hollow tubular member is a quartz tube.
19. A thermal processing unit according to claim 17 or 18, wherein the temperature measuring unit is arranged in a vicinity of the heating unit.
20. A thermal processing unit according to any of claims 17 to 19, wherein
  - the hollow tubular member is rotatably inserted through the reaction-tube lower lid into the reaction tube.
21. A thermal processing unit according to claim 20, wherein
  - the hollow tubular member is rotatably and removably supported with respect to the reaction-tube lower lid.

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22. A thermal processing unit according to claim 20 or 21, wherein the hollow tubular member is removably supported with respect to the substrate-to-be-processed supporting member.

23. A thermal processing unit according to any of claims 17 to 22, wherein

the substrate-to-be-processed supporting member is adapted to horizontally support a plurality of substrates to be processed; and

a portion of the hollow tubular member can be located in a gap between the plurality of substrates to be processed supported by the substrate-to-be-processed supporting member.

24. A thermal processing unit according to any of claims 17 to 23, wherein

the hollow tubular member has a branched portion, and

the plurality of temperature measuring members are also arranged in the branched portion.

25. A thermal processing unit according to any of claims 17 to 22, wherein

the hollow tubular member has:

a vertical portion extending upward along an inside wall of the reaction tube,

a bend portion bent from the vertical portion at an upper portion of the reaction tube, and

a horizontal portion extending horizontally from the bend portion.

26. A thermal processing unit according to claim 25, wherein the hollow tubular member has:

a branch portion branched from the vertical portion at a middle portion of the reaction tube in a longitudinal direction, and

a second horizontal portion extending horizontally from the branch portion.

27. A thermal processing unit according to claim 17 or 18, wherein the hollow tubular member is arranged in a gap between the

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heating-furnace body and the reaction tube.

28. A thermal processing unit comprising:

- a heating-furnace body whose upper end has an opening,
- a reaction tube consisting of a single tube contained in the heating-furnace body,

- a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,

- a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,

- a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member,

- a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube,

- a first temperature measuring unit formed by sealing a plurality of temperature measuring members into a first hollow tubular member,

- a second temperature measuring unit formed by sealing a plurality of temperature measuring members into a second hollow tubular member, and

- a third temperature measuring unit formed by sealing a plurality of temperature measuring members into a third hollow tubular member,

- wherein at least a portion of the first hollow tubular member extends horizontally from a middle portion of the reaction tube in a longitudinal direction,

- at least a portion of the second hollow tubular member extends horizontally from an upper portion of the reaction tube, and

- at least a portion of the third hollow tubular member is arranged in a gap between the heating-furnace body and the reaction tube.

29. A thermal processing unit comprising:

- a heating-furnace body whose upper end has an opening,

- a reaction tube consisting of a single tube contained in the heating-furnace body,

- a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion

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having a narrow diameter,

a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,

a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member,

a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube,

a second temperature measuring unit formed by sealing a plurality of temperature measuring members into a second hollow tubular member, and

a third temperature measuring unit formed by sealing a plurality of temperature measuring members into a third hollow tubular member,

wherein at least a portion of the second hollow tubular member extends horizontally from an upper portion of the reaction tube, and

at least a portion of the third hollow tubular member is arranged in a gap between the heating-furnace body and the reaction tube.

30. A thermal processing unit comprising:

a heating-furnace body whose upper end has an opening,

a reaction tube consisting of a single tube contained in the heating-furnace body,

a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,

a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,

a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member,

a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube, and

two holes formed respectively at an upper portion and a lower portion in a gap between the heating-furnace body and the reaction tube,

wherein a cooling medium is introduced from one of the two holes and discharged from the other of the two holes in order to cool the reaction tube.

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31. A thermal processing unit comprising:  
a heating-furnace body whose upper end has an opening,  
a reaction tube consisting of a single tube contained in the heating-furnace body,  
a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,  
a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,  
a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member,  
a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube,  
a second temperature measuring unit formed by sealing a plurality of temperature measuring members into a second hollow tubular member, and  
a third temperature measuring unit formed by sealing a plurality of temperature measuring members into a third hollow tubular member, wherein the heating unit has:  
a first heating portion arranged around the reaction tube,  
a second heating portion arranged around the gas-discharging-unit connecting portion,  
a third heating portion arranged around an upper portion of the reaction tube,  
a fourth heating portion arranged around a lower portion of the reaction tube, and  
a fifth heating portion arranged under the substrate-to-be-processed supporting member,  
at least a portion of the second hollow tubular member extends horizontally from an upper portion of the reaction tube, and  
at least a portion of the third hollow tubular member is arranged in a gap between the heating-furnace body and the reaction tube.
32. A thermal processing unit comprising:  
a heating-furnace body whose upper end has an opening,  
a reaction tube consisting of a single tube contained in the

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heating-furnace body,

a gas-discharging-unit connecting portion formed at an upper portion of the reaction tube, the gas-discharging-unit connecting portion having a narrow diameter,

a substrate-to-be-processed supporting member for supporting a substrate to be processed, contained in the heating-furnace body,

a heating unit for heating the substrate to be processed supported by the substrate-to-be-processed supporting member,

a reaction-tube lower lid that seals a lower portion of the reaction tube and holds airtightness in the reaction tube,

a first temperature measuring unit formed by sealing a plurality of temperature measuring members into a first hollow tubular member,

a second temperature measuring unit formed by sealing a plurality of temperature measuring members into a second hollow tubular member, and

a third temperature measuring unit formed by sealing a plurality of temperature measuring members into a third hollow tubular member,

wherein the heating unit has:

a first heating portion arranged around the reaction tube,

a second heating portion arranged around the gas-discharging-unit connecting portion,

a third heating portion arranged around an upper portion of the reaction tube,

a fourth heating portion arranged around a lower portion of the reaction tube, and

a fifth heating portion arranged under the substrate-to-be-processed supporting member,

at least a portion of the first hollow tubular member extends horizontally from a middle portion of the reaction tube in a longitudinal direction,

at least a portion of the second hollow tubular member extends horizontally from an upper portion of the reaction tube, and

at least a portion of the third hollow tubular member is arranged in a gap between the heating-furnace body and the reaction tube.

33. A thermal processing unit according to claim 31 or 32, wherein

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a temperature controlling unit is provided around the gas-discharging-unit connecting portion.

34. A thermal processing unit according to claim 33, wherein the temperature controlling unit is a heat-insulating material.
35. A thermal processing unit according to claim 33, wherein the temperature controlling unit is a resistance heater.
36. A thermal processing unit according to claim 34 or 35, wherein the temperature controlling unit has flexibility.
37. A thermal processing unit according to claim 34 or 35, wherein the temperature controlling unit is shaped in advance.
38. A thermal processing unit according to any of claims 31 to 37, wherein  
the gas-discharging unit is a gas-discharging pipe whose end portion has a flange,  
a flange is formed at an end portion of the gas-discharging-unit connecting portion, and  
the flange at the end portion of the gas-discharging-unit connecting portion and the flange at the end portion of the gas-discharging pipe are hermetically connected to each other by means of a sealing unit.
39. A thermal processing unit according to claim 38, wherein the temperature controlling unit has a fluid hole provided in the flange.

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